

**EMPIRICAL FORMULA FOR INTERPOLATION  
OF TABULATED PHOTON PHOTOELECTRIC  
CROSS SECTIONS**

**Donald L. Smith**



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Donald L. Smith

Applied Physics Division

March 1971



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# EMPIRICAL FORMULA FOR INTERPOLATION OF TABULATED PHOTON PHOTOELECTRIC CROSS SECTIONS

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## ABSTRACT

The empirical formula

$$\sigma_T(E_\gamma) = \exp \left[ p_1 + \left( \sum_{i=2}^k p_i E_\gamma^{i-2} \right) \ln E_\gamma \right]$$

has been useful in the calculation of total photoelectric cross sections for photon energies  $E_\gamma$  not listed in tables. The parameters  $p_i$  are determined by least-squares fitting of the formula to tabulated values at neighboring energies. The number of parameters required for a satisfactory fit depends upon the atomic number of the element, the photon-energy range over which the formula is to be applied, and the desired accuracy. This formula has been used to fit total photoelectric cross sections for elements  $Z = 1$  to 100 from  $E_\gamma = 1$  keV to 100 MeV photon energy. An agreement between the formula and the tabulated values of better than  $\pm 3\%$  was sought and obtained. The parameters  $p_i$  extracted from the analysis are presented in this report.

## I. INTRODUCTION

The photoelectric effect is that process whereby an atom absorbs an incident photon and emits an electron. The atom is left in an excited state and subsequently returns to the ground state by emission of Auger electrons or X rays. Photoelectric absorption is the most important interaction process for low-energy photons when the photon energy exceeds that required to eject the most weakly bound electrons of the atoms in the medium. More detailed physical descriptions of this process can be found elsewhere (e.g., Refs. 1 and 2).

Knowledge of photoelectric and other photon cross sections is essential for radiation-shielding calculations and in the analysis of heating effects resulting from photon-energy deposition in materials such as those situated in reactor cores or in the environment of a nuclear explosion. Photon cross sections must also be known in order to correct for self-absorption of gamma rays emitted by radioactive materials.

Photoelectric cross sections are difficult to measure and to calculate. There have been many compilations of these cross sections. The older compilations are less reliable, because improvements in theoretical and experimental techniques have prompted major revisions of the cross-section values during the past several years. The task has not been completed because there still remain significant uncertainties in the available cross sections.

## II. ANALYSIS

Since most of the available photon cross sections are in tabular form, it is necessary to interpolate empirically in order to determine cross-section values at energies not found in the tables. The photoelectric cross section varies smoothly with energy, except at the absorption edges. At these edges, the cross section shows discontinuous jumps when the energy  $E_\gamma$  falls below the binding energy of some of the electrons, so that the number of electrons it is energetically possible to eject is suddenly decreased. Evans indicates that away from the absorption edges, the energy dependence of the photoelectric cross section  $\sigma_\tau$  is characterized by the expression

$$\sigma_\tau(E_\gamma) \sim CE_\gamma^{-n}, \quad (1)$$

where  $C$  is a constant and  $n$  is a slowly varying function of photon energy.<sup>1</sup> Photoelectric cross sections appear to be nearly linear over moderate energy ranges when plotted on log-log paper. This fact suggests use of the expression

$$\ln[\sigma_\tau(E_\gamma)] \sim C_1 + C_2 \ln E_\gamma, \quad (2)$$

with constants  $C_1$  and  $C_2$ , for limited-range interpolation with cross-section tables. Equation 2 is equivalent to Eq. 1 when  $n$  is constant.

It is suggested here that a convenient generalization of Eq. 2, which is also consistent with Eq. 1, is the empirical formula

$$\ln[\sigma_\tau(E_\gamma)] = p_1 + \left( \sum_{i=2}^k p_i E_\gamma^{i-2} \right) \ln E_\gamma, \quad (3)$$

where the  $p_i$  ( $i = 1, \dots, k$ ) are constant parameters. Equation 3 is equivalent to Eq. 1 when the energy dependence of  $n$  is approximated by the polynomial

$$n = - \sum_{i=2}^k p_i E_\gamma^{i-2}. \quad (4)$$

The number  $k$  of parameters  $p_i$  used in Eq. 3 is left to the discretion of the user. The photoelectric cross section  $\sigma_\tau(E_\gamma)$  is then given directly by the formula

$$\sigma_T(E_\gamma) = \exp \left[ p_1 + \left( \sum_{i=2}^k p_i E_\gamma^{i-2} \right) \ln E_\gamma \right]. \quad (5)$$

A recent comprehensive compilation of photon cross sections is that of Storm and Israel.<sup>3</sup> These authors have tabulated the principal photon cross sections, including those for the photoelectric effect, for elements  $Z = 1$  to 100 from  $E_\gamma = 1$  keV to 100 MeV. The bibliography of their paper is an excellent source of references on photon cross sections. The approximate accuracy claimed for the photoelectric cross sections in their compilation is as follows:  $1 \text{ keV} \leq E_\gamma < 6 \text{ keV}$  ( $\pm 10\%$ ),  $6 \text{ keV} \leq E_\gamma < 200 \text{ keV}$  ( $\pm 3\%$ ), and  $200 \text{ keV} \leq E_\gamma$  ( $\pm 10\%$ ).

Equation 5 has been used with considerable success to fit the total photoelectric cross sections [ $\sigma(\text{photo})$  in the notation of Ref. 3] compiled by Storm and Israel. The method of least squares was used in the fitting calculations. Sets of parameters  $p_i$  were sought which would minimize the expression

$$R = \sum_{j=1}^N \left\{ \ln [\sigma_T(E_{\gamma_j})] - \ln \sigma_{Tj}^{\text{TAB}} \right\}^2 \quad (6)$$

for selected ranges of photon energy. Use of Eq. 3 for  $\ln[\sigma_T(E_\gamma)]$  in Eq. 6 leads to a system of equations which are linear in the parameters  $p_i$  and can be solved easily to determine the best fit. The quantities  $\sigma_{Tj}^{\text{TAB}}$  are the tabulated cross sections corresponding to photon energies  $E_{\gamma_j}$ . Except near absorption edges, the energy intervals chosen for the fittings include about an order-of-magnitude range in  $E_\gamma$  (e.g., 1 to 10 keV, 100 keV to 1 MeV, etc.). The number of parameters  $k$  used in each fitting was determined from the criterion that the cross sections computed from Eq. 5 should agree with the tabulated values (in the energy interval) to within  $\pm 3\%$  or better.

The sets of parameters  $p_i$  generated by this fitting analysis appear in Table I in the appendix. The quality of the fits of Eq. 5 to the total photoelectric cross sections of Storm and Israel is demonstrated by the results for germanium ( $Z = 32$ ), which appear in Table II in the appendix.

### III. CONCLUDING REMARK

With the aid of Eq. 5 and the parameters  $p_i$  in Table I, one can easily compute values of the total photoelectric cross section which are compatible with the Storm and Israel tables to within  $\pm 3\%$  for all the elements from  $Z = 1$  to 100.

## APPENDIX

Tabular Results

The complete results of fitting Eq. 5 in Section II to the photon total photoelectric cross sections compiled by Storm and Israel<sup>3</sup> are presented in Tables I and II of this appendix.

TABLE I. Parameters for Best Fits of  $\sigma_T = \exp \left[ p_1 + \left( \sum_{i=2}^k p_i E_Y^{i-2} \right) \ln E_Y \right]$  to the Photon Total Photoelectric Cross Sections Compiled by Storm and Israel<sup>3</sup> for Elements Z = 1 to Z = 100 from 1-keV to 100-MeV Photon Energy<sup>a</sup>

Z	Element	Photon Energy Range, keV	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	P <sub>4</sub>	P <sub>5</sub>
1	Hydrogen	1.0(0)-1.5(1)	2.445(0)	-3.384(0)	-1.292(-3)		
2	Helium	1.0(0)-1.0(1) 1.0(1)-4.0(1)	6.014(0) 6.014(0)	-3.284(0) -3.380(0)	-2.586(-2)	1.660(-3)	
3	Lithium	1.0(0)-1.0(1) 1.0(1)-8.0(1)	7.899(0) 8.066(0)	-3.152(0) -3.353(0)	-3.048(-2)	1.813(-3)	
4	Beryllium	1.0(0)-1.0(1) 1.0(1)-1.0(2)	9.110(0) 9.465(0)	-2.995(0) -3.340(0)	-4.456(-2)	2.530(-3)	
5	Boron	1.0(0)-1.0(1) 1.0(1)-1.5(2)	9.997(0) 1.049(1)	-2.894(0) -3.321(0)	-3.893(-2)	1.693(-3)	
6	Carbon	1.0(0)-1.0(1) 1.0(1)-2.0(2)	1.068(1) 1.126(1)	-2.786(0) -3.286(0)	-4.558(-2) -4.979(-5)	1.950(-3)	
7	Nitrogen	1.0(0)-1.0(1) 1.0(1)-3.0(2)	1.125(1) 1.178(1)	-2.727(0) -3.210(0)	-4.569(-2) -4.717(-4)	1.926(-3)	
8	Oxygen	1.0(0)-1.0(1) 1.0(1)-1.0(2) 1.0(2)-4.0(2)	1.171(1) 1.231(1) 1.307(1)	-2.661(0) -3.187(0) -3.407(0)	-4.546(-2) -3.488(-4) 2.078(-4)	1.834(-3)	
9	Fluorine	1.0(0)-1.0(1) 1.0(1)-1.0(2) 1.0(2)-4.0(2)	1.211(1) 1.286(1) 1.361(1)	-2.574(0) -3.191(0) -3.401(0)	-5.648(-2) -2.525(-4) -2.018(-4)	2.743(-3)	
10	Neon	1.0(0)-1.0(1) 1.0(1)-1.0(2) 1.0(2)-6.0(2)	1.245(1) 1.325(1) 1.399(1)	-2.513(0) -3.162(0) -3.375(0)	-5.912(-2) -3.138(-4)	2.856(-3)	
11	Sodium	1.0(0)-1.073(0) K 1.073(0)-1.0(1) 1.0(1)-1.0(2) 1.0(2)-6.0(2)	1.009(1) 1.275(1) 1.346(1) 1.414(1)	-2.286(0) -2.455(0) -3.089(0) -3.311(0)	-6.329(-2) -5.884(-4)	3.006(-3)	
12	Magnesium	1.0(0)-1.305(0) K 1.305(0)-1.0(1) 1.0(1)-1.0(2) 1.0(2)-8.0(2)	1.049(1) 1.303(1) 1.378(1) 1.484(1)	-2.573(0) -2.443(0) -3.070(0) -3.372(0)	-5.693(-2) -5.589(-4)	2.615(-3)	
13	Aluminum	1.0(0)-1.56(0) K 1.56(0)-1.0(1) 1.0(1)-1.0(2) 1.0(2)-8.0(2)	1.087(1) 1.327(1) 1.414(1) 1.484(1)	-2.662(0) -2.390(0) -3.075(0) -3.372(0)	-6.159(-2) -4.321(-4)	3.048(-3)	
14	Silicon	1.0(0)-1.839(0) K 1.839(0)-1.0(1) 1.0(1)-1.0(2) 1.0(2)-1.0(3)	1.118(1) 1.357(1) 1.434(1) 1.523(1)	-2.653(0) -2.555(0) -3.033(0) -3.373(0)	-1.623(-2) -5.219(-4)	1.924(-4)	
15	Phosphorus	1.0(0)-2.144(0) K 2.144(0)-1.0(1) 1.0(1)-1.0(2) 1.0(2)-1.5(3)	1.147(1) 1.381(1) 1.455(1) 1.613(1)	-2.642(0) -2.552(0) -3.007(0) -3.430(0)	-1.442(-2) -5.611(-4)		
16	Sulfur	1.0(0)-2.472(0) K 2.472(0)-1.0(1) 1.0(1)-1.0(2) 1.0(2)-1.5(3)	1.174(1) 1.401(1) 1.477(1) 1.643(1)	-2.496(0) -2.546(0) -2.988(0) -3.430(0)	-6.132(-2) -1.267(-2) -5.743(-4)		
					2.648(-4)	-4.711(-8)	

<sup>a</sup>Numerical notation: A(n) ≡ A × 10<sup>n</sup>. The positions of the absorption edges (K, L1, ...) are labeled. With photon energies in keV, the parameters of this table yield  $\sigma_T$  in barns. The Storm and Israel tables do not list cross sections when they are ≤ 0.001 barn.<sup>3</sup>

TABLE I (Contd.)

Z	Element	Photon Energy Range, keV	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	P <sub>4</sub>	P <sub>5</sub>
17	Chlorine	1.0(0)-2.824(0) K	1.199(1)	-2.506(0)	-5.138(-2)		
		2.824(0)-1.0(1)	1.420(1)	-2.525(0)	-1.244(-2)		
		1.0(1)-1.0(2)	1.497(1)	-2.974(0)	-5.528(-4)		
		1.0(2)-2.0(3)	1.662(1)	-3.409(0)	2.518(-4)	-4.183(-8)	
18	Argon	1.0(0)-3.203(0) K	1.223(1)	-2.533(0)	-3.769(-2)		
		3.203(0)-1.0(1)	1.438(1)	-2.511(0)	-1.207(-2)		
		1.0(1)-1.0(2)	1.514(1)	-2.948(0)	-6.073(-4)		
		1.0(2)-2.0(3)	1.679(1)	-3.389(0)	2.461(-4)	-4.058(-8)	
19	Potassium	1.0(0)-3.607(0) K	1.246(1)	-2.543(0)	-3.396(-2)		
		3.607(0)-1.0(1)	1.454(1)	-2.503(0)	-1.102(-2)		
		1.0(1)-1.0(2)	1.530(1)	-2.928(0)	-6.301(-4)		
		1.0(2)-3.0(3)	1.708(1)	-3.400(0)	2.719(-4)	-6.667(-8)	7.676(-12)
20	Calcium	1.0(0)-4.037(0) K	1.268(1)	-2.580(0)	-2.296(-2)		
		4.037(0)-1.0(1)	1.474(1)	-2.533(0)	-8.437(-3)		
		1.0(1)-1.0(2)	1.544(1)	-2.905(0)	-6.838(-4)		
		1.0(2)-4.0(3)	1.710(1)	-3.352(0)	2.422(-4)	-4.896(-8)	4.318(-12)
21	Scandium	1.0(0)-4.491(0) K	1.286(1)	-2.539(0)	-2.777(-2)		
		4.491(0)-1.0(1)	1.508(1)	-2.680(0)			
		1.0(1)-1.0(2)	1.557(1)	-2.883(0)	-6.990(-4)		
		1.0(2)-1.0(3)	1.699(1)	-3.275(0)	1.727(-4)		
		1.0(3)-5.0(3)	1.233(1)	-2.496(0)	7.074(-5)	-4.655(-9)	
22	Titanium	1.0(0)-4.966(0) K	1.303(1)	-2.530(0)	-2.574(-2)		
		4.966(0)-1.0(2)	1.511(1)	-2.569(0)	-6.452(-3)	7.051(-5)	-2.958(-7)
		1.0(2)-1.0(3)	1.744(1)	-3.332(0)	2.307(-4)	3.488(-8)	
		1.0(3)-6.0(3)	1.164(1)	-2.351(0)	5.566(-5)	-3.216(-9)	
23	Vanadium	1.0(0)-5.465(0) K	1.319(1)	-2.518(0)	-2.452(-2)		
		5.465(0)-1.0(2)	1.523(1)	-2.556(0)	-6.201(-3)	6.493(-5)	-2.630(-7)
		1.0(2)-1.0(3)	1.745(1)	-3.289(0)	2.026(-4)	-2.082(-8)	
		1.0(3)-6.0(3)	1.192(1)	-2.362(0)	5.701(-5)	-3.443(-9)	
24	Chromium	1.0(0)-5.989(0) K	1.335(1)	-2.505(0)	-2.434(-2)		
		5.989(0)-1.0(2)	1.574(1)	-2.619(0)	-3.374(-3)	1.597(-5)	
		1.0(2)-1.0(3)	1.743(1)	-3.241(0)	1.672(-4)		
		1.0(3)-8.0(3)	1.140(1)	-2.247(0)	4.516(-5)	-2.312(-9)	
25	Manganese	1.0(0)-6.539(0) K	1.350(1)	-2.503(0)	-2.213(-2)		
		6.539(0)-1.0(2)	1.563(1)	-2.627(0)	-3.050(-3)	1.394(-5)	
		1.0(2)-1.0(3)	1.754(1)	-3.227(0)	1.641(-4)		
		1.0(3)-8.0(3)	1.137(1)	-2.212(0)	4.200(-5)	-2.104(-9)	
26	Iron	1.0(0)-7.112(0) K	1.364(1)	-2.499(0)	-2.116(-2)		
		7.112(0)-1.0(2)	1.573(1)	-2.611(0)	-3.051(-3)	1.388(-5)	
		1.0(2)-1.0(3)	1.771(1)	-3.224(0)	1.648(-4)		
		1.0(3)-1.0(4)	1.079(1)	-2.093(0)	3.228(-5)	-1.383(-9)	
27	Cobalt	1.0(0)-7.709(0) K	1.378(1)	-2.489(0)	-2.031(-2)		
		7.709(0)-1.0(2)	1.583(1)	-2.597(0)	-2.974(-3)	1.311(-5)	
		1.0(2)-1.0(3)	1.777(1)	-3.203(0)	1.588(-4)		
		1.0(3)-1.0(4)	1.088(1)	-2.079(0)	3.096(-5)	-1.306(-9)	
28	Nickel	1.0(0)-1.008(0) L1	1.377(1)	-1.324(0)			
		1.008(0)-8.332(0) K	1.392(1)	-2.504(0)	-1.701(-2)		
		8.332(0)-1.0(2)	1.594(1)	-2.591(0)	-2.907(-3)	1.284(-5)	
		1.0(2)-1.0(3)	1.792(1)	-3.200(0)	1.595(-4)		
		1.0(3)-1.5(4)	1.190(1)	-2.213(0)	4.511(-5)	-3.191(-9)	8.847(-14)
29	Copper	1.0(0)-1.096(0) L1	1.391(1)	-2.660(0)			
		1.096(0)-8.981(0) K	1.402(1)	-2.348(0)	-6.344(-2)	3.607(-3)	
		8.981(0)-1.0(2)	1.603(1)	-2.579(0)	-2.853(-3)	1.232(-5)	
		1.0(2)-1.0(3)	1.805(1)	-3.196(0)	1.601(-4)		
		1.0(3)-1.5(4)	1.201(1)	-2.204(0)	4.401(-5)	-3.061(-9)	8.295(-14)
30	Zinc	1.0(0)-1.02(0) L3	1.202(1)	-2.176(0)			
		1.02(0)-1.043(0) L2	1.378(1)	-5.959(0)			
		1.043(0)-1.193(0) L1	1.400(1)	-2.367(0)			
		1.193(0)-9.659(0) K	1.413(1)	-2.327(0)	-6.218(-2)	3.299(-3)	
		9.659(0)-1.0(2)	1.614(1)	-2.576(0)	-2.721(-3)	1.160(-5)	
		1.0(2)-1.0(3)	1.818(1)	-3.192(0)	1.616(-4)		
		1.0(3)-2.0(4)	1.148(1)	-2.094(0)	3.272(-5)	-1.845(-9)	4.012(-14)

TABLE I (Contd.)

Z	Element	Photon Energy Range, keV	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	P <sub>4</sub>	P <sub>5</sub>
31	Gallium	1.0(0)-1.115(0) L3 1.115(0)-1.142(0) L2 1.142(0)-1.3(0) L1 1.3(0)-1.0367(1) K 1.0367(1)-1.0(2) 1.0(2)-1.0(3) 1.0(3)-2.0(4)	1.218(1) 1.416(1) 1.411(1) 1.426(1) 1.624(1) 1.830(1) 1.170(1)	-2.410(0) -5.458(0) -2.336(0) -2.335(0) -2.573(0) -3.186(0) -2.104(0)	-5.662(-2) -2.554(-3) 1.610(-4) 3.310(-5)	2.787(-3) 1.037(-5)	
32	Germanium	1.0(0)-1.217(0) L3 1.217(0)-1.248(0) L2 1.248(0)-1.413(0) L1 1.413(0)-1.1104(1) K 1.1104(1)-1.0(2) 1.0(2)-1.0(3) 1.0(3)-2.0(4)	1.233(1) 1.446(1) 1.420(1) 1.443(1) 1.633(1) 1.840(1) 1.189(1)	-2.366(0) -5.051(0) -2.280(0) -2.517(0) -2.562(0) -3.179(0) -2.111(0)	-1.242(-2) -2.562(-3) 1.606(-4) 3.331(-5)	1.051(-5)	4.025(-14)
33	Arsenic	1.0(0)-1.323(0) L3 1.323(0)-1.359(0) L2 1.359(0)-1.53(0) L1 1.53(0)-1.1867(1) K 1.1867(1)-1.0(2) 1.0(2)-1.0(3) 1.0(3)-1.0(4) 1.0(4)-3.0(4)	1.247(1) 1.472(1) 1.426(1) 1.449(1) 1.643(1) 1.855(1) 1.217(1) 6.218(0)	-2.382(0) -4.817(0) -2.179(0) -2.360(0) -2.563(0) -3.184(0) -2.128(0) -1.306(0)	-4.540(-2) -2.365(-3) 1.643(-4) 3.188(-5)	1.995(-3) 9.183(-6)	4.012(-14)
34	Selenium	1.0(0)-1.434(0) L3 1.434(0)-1.475(0) L2 1.475(0)-1.652(0) L1 1.652(0)-1.2658(1) K 1.2658(1)-1.0(2) 1.0(2)-1.0(3) 1.0(3)-1.0(4) 1.0(4)-3.0(4)	1.261(1) 1.481(1) 1.437(1) 1.458(1) 1.676(1) 1.862(1) 1.211(1) 6.308(0)	-2.372(0) -4.239(0) -2.247(0) -2.348(0) -2.669(0) -3.170(0) -2.098(0) -1.300(0)	-4.349(-2) -8.521(-4) 1.608(-4) 3.020(-5)	1.796(-3)	
35	Bromine	1.0(0)-1.551(0) L3 1.551(0)-1.597(0) L2 1.597(0)-1.782(0) L1 1.782(0)-1.3474(1) K 1.3474(1)-1.0(2) 1.0(2)-1.0(3) 1.0(3)-1.0(4) 1.0(4)-3.0(4)	1.275(1) 1.491(1) 1.448(1) 1.470(1) 1.683(1) 1.871(1) 1.229(1) 6.284(0)	-2.392(0) -3.918(0) -2.277(0) -2.354(0) -2.657(0) -3.163(0) -2.105(0) -1.282(0)	-4.097(-2) -8.462(-4) 1.593(-4) 3.037(-5)	1.619(-3)	
36	Krypton	1.0(0)-1.675(0) L3 1.675(0)-1.727(0) L2 1.727(0)-1.921(0) L1 1.921(0)-1.4323(1) K 1.4323(1)-1.0(2) 1.0(2)-1.0(3) 1.0(3)-1.0(4) 1.0(4)-4.0(4)	1.288(1) 1.499(1) 1.448(1) 1.481(1) 1.693(1) 1.875(1) 1.239(1) 5.873(0)	-2.385(0) -3.638(0) -2.289(0) -2.377(0) -2.655(0) -3.147(0) -2.101(0) -1.221(0)	-3.588(-2) -8.347(-4) 1.557(-4) 3.022(-5)	1.337(-3)	
37	Rubidium	1.0(0)-1.805(0) L3 1.805(0)-1.863(0) L2 1.863(0)-2.065(0) L1 2.065(0)-1.52(1) K 1.52(1)-1.0(2) 1.0(2)-1.0(3) 1.0(3)-1.0(4) 1.0(4)-4.0(4)	1.300(1) 1.512(1) 1.466(1) 1.489(1) 1.699(1) 1.881(1) 1.246(1) 5.980(0)	-2.376(0) -3.550(0) -2.288(0) -2.354(0) -2.642(0) -3.136(0) -2.093(0) -1.219(0)	-3.627(-2) -8.511(-4) 1.543(-4) 2.953(-5)		-1.235(-9)
38	Strontium	1.0(0)-1.94(0) L3 1.94(0)-2.007(0) L2 2.007(0)-2.216(0) L1 2.216(0)-1.6105(1) K 1.6105(1)-1.0(2) 1.0(2)-1.0(3) 1.0(3)-1.0(4) 1.0(4)-5.0(4)	1.312(1) 1.524(1) 1.480(1) 1.502(1) 1.708(1) 1.887(1) 1.258(1) 5.749(0)	-2.379(0) -3.471(0) -2.350(0) -2.403(0) -2.643(0) -3.125(0) -2.092(0) -1.179(0)	-2.726(-2) -8.213(-4) 1.527(-4) 2.948(-5)	8.769(-4)	
					3.731(-7)	-1.200(-9)	

TABLE I (Contd.)

Z	Element	Photon Energy Range, keV	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	P <sub>4</sub>	P <sub>5</sub>
39	Yttrium	1.0(0)-2.079(0) L3 2.079(0)-2.155(0) L2 2.155(0)-2.373(0) L1 2.373(0)-1.7038(1) K 1.7038(1)-1.0(2) 1.0(2)-1.0(3) 1.0(3)-1.0(4) 1.0(4)-6.0(4)	1.324(1) 1.498(1) 1.490(1) 1.524(1) 1.712(1) 1.893(1) 1.276(1) 5.506(0)	-2.378(0) -2.902(0) -2.370(0) -2.570(0) -2.625(0) -3.113(0) -2.101(0) -1.139(0)	-5.500(-3) -8.559(-4) 1.507(-4) 2.996(-5) 2.065(-7)		-1.232(-9)
40	Zirconium	1.0(0)-2.223(0) L3 2.223(0)-2.307(0) L2 2.307(0)-2.533(0) L1 2.533(0)-1.7998(1) K 1.7998(1)-1.0(2) 1.0(2)-1.0(3) 1.0(3)-1.0(4) 1.0(4)-6.0(4)	1.336(1) 1.495(1) 1.498(1) 1.533(1) 1.724(1) 1.898(1) 1.282(1) 5.666(0)	-2.384(0) -2.714(0) -2.376(0) -2.573(0) -2.637(0) -3.101(0) -2.093(0) -1.144(0)	-4.962(-3) -7.605(-4) 1.478(-4) 2.939(-5) 2.087(-7)		-1.197(-9)
41	Niobium	1.0(0)-2.37(0) L3 2.37(0)-2.464(0) L2 2.464(0)-2.698(0) L1 2.698(0)-1.8986(1) K 1.8986(1)-1.0(2) 1.0(2)-1.0(3) 1.0(3)-1.0(4) 1.0(4)-6.0(4)	1.347(1) 1.490(1) 1.507(1) 1.528(1) 1.730(1) 1.907(1) 1.507(1) 5.820(0)	-2.389(0) -2.536(0) -2.380(0) -2.397(0) -2.630(0) -3.099(0) -2.433(0) -1.149(0)	-2.338(-2) -7.372(-4)	6.440(-4)	
42	Molybdenum	1.0(0)-2.521(0) L3 2.521(0)-2.625(0) L2 2.625(0)-2.867(0) L1 2.867(0)-2.0(1) K 2.0(1)-1.0(2) 1.0(2)-1.0(3) 1.0(3)-1.0(4) 1.0(4)-8.0(4)	1.356(1) 1.490(1) 1.517(1) 1.552(1) 1.741(1) 1.908(1) 1.288(1) 5.822(0)	-2.252(0) -2.446(0) -2.398(0) -2.573(0) -2.636(0) -3.079(0) -2.068(0) -1.137(0)	-4.475(-3) -6.920(-4) 1.422(-4) 2.809(-5) 1.651(-7)		-1.136(-9)
43	Technetium	1.0(0)-2.677(0) L3 2.677(0)-2.793(0) L2 2.793(0)-3.043(0) L1 3.043(0)-2.1044(1) K 2.1044(1)-1.0(2) 1.0(2)-1.0(3) 1.0(3)-1.0(4) 1.0(4)-8.0(4)	1.367(1) 1.503(1) 1.532(1) 1.548(1) 1.740(1) 1.904(1) 1.312(1) 5.958(0)	-2.253(0) -2.493(0) -2.462(0) -2.435(0) -2.604(0) -3.048(0) -2.089(0) -1.140(0)	-5.560(-2) -7.932(-4)	3.792(-4)	
44	Ruthenium	1.0(0)-2.838(0) L3 2.838(0)-2.967(0) L2 2.967(0)-3.224(0) L1 3.224(0)-2.2117(1) K 2.2117(1)-1.0(2) 1.0(2)-1.0(3) 1.0(3)-1.0(4) 1.0(4)-1.0(5)	1.377(1) 1.507(1) 1.538(1) 1.555(1) 1.743(1) 1.904(1) 1.321(1) 5.999(0)	-2.249(0) -2.453(0) -2.449(0) -2.430(0) -2.590(0) -3.013(0) -2.220(0) -1.134(0)	-5.526(-2) -7.932(-4)	3.476(-4)	
45	Rhodium	1.0(0)-3.004(0) L3 3.004(0)-3.146(0) L2 3.146(0)-3.412(0) L1 3.412(0)-2.322(1) K 2.322(1)-1.0(2) 1.0(2)-1.0(3) 1.0(3)-1.0(4) 1.0(4)-1.0(5)	1.386(1) 1.522(1) 1.555(1) 1.564(1) 1.751(1) 1.922(1) 1.543(1) 6.120(0)	-2.227(0) -2.518(0) -2.534(0) -2.435(0) -2.592(0) -3.048(0) -2.423(0) -1.136(0)	-5.838(-2) -8.013(-4)	4.831(-7)	-2.230(-10)
46	Palladium	1.0(0)-3.174(0) L3 3.174(0)-3.33(0) L2 3.33(0)-3.605(0) L1 3.605(0)-2.435(1) K 2.435(0)-1.0(2) 1.0(2)-1.0(3) 1.0(3)-1.0(4) 1.0(4)-1.0(5)	1.395(1) 1.607(1) 1.523(1) 1.572(1) 1.750(1) 1.928(1) 1.345(1) 6.287(0)	-2.216(0) -3.187(0) -2.219(0) -2.435(0) -2.566(0) -3.042(0) -2.091(0) -1.144(0)	-5.990(-2) -7.843(-4)	2.783(-4)	
					1.377(-4)	1.379(-4)	2.857(-5)
					-1.147(-9)		

TABLE I (Contd.)

Z	Element	Photon Energy Range, keV	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	P <sub>4</sub>	P <sub>5</sub>
47	Silver	1.0(0)-3.351(0) L3	1.404(1)	-2.216(0)	-5.800(-2)		
		3.351(0)-3.524(0) L2	1.537(1)	-2.516(0)			
		3.524(0)-3.806(0) L1	1.567(1)	-2.502(0)			
		3.806(0)-2.5514(1) K	1.580(1)	-2.442(0)	-1.292(-2)	2.483(-4)	
		2.5514(1)-1.0(2)	1.762(1)	-2.582(0)	-6.917(-4)		
		1.0(2)-1.0(3)	1.934(1)	-3.037(0)	1.367(-4)		
		1.0(3)-1.0(4)	1.355(1)	-2.092(0)	2.885(-5)	-1.178(-9)	
		1.0(4)-1.0(5)	6.240(0)	-1.129(0)	1.362(-7)		
48	Cadmium	1.0(0)-3.537(0) L3	1.413(1)	-2.223(0)	-5.259(-2)		
		3.537(0)-3.727(0) L2	1.540(1)	-2.476(0)			
		3.727(0)-4.018(0) L1	1.588(1)	-2.598(0)			
		4.018(0)-2.6711(1) K	1.590(1)	-2.462(0)	-1.111(-2)	1.973(-4)	
		2.6711(1)-1.0(2)	1.767(1)	-2.574(0)	-6.869(-4)		
		1.0(2)-1.0(3)	1.938(1)	-3.027(0)	1.355(-4)		
49	Indium	1.0(3)-1.0(4)	1.368(1)	-2.096(0)	2.892(-5)	-1.181(-9)	
		1.0(4)-1.0(5)	6.390(0)	-1.135(0)	1.505(-7)		
50	Tin	1.0(0)-3.730(0) L3	1.421(1)	-2.228(0)	-4.775(-2)		
		3.730(0)-3.938(0) L2	1.555(1)	-2.526(0)			
		3.938(0)-4.238(0) L1	1.596(1)	-2.597(0)			
		4.238(0)-2.794(1) K	1.615(1)	-2.604(0)	-2.403(-3)		
		2.794(1)-1.0(2)	1.771(1)	-2.565(0)	-6.932(-4)		
		1.0(2)-1.0(3)	1.942(1)	-3.017(0)	1.339(-4)		
		1.0(3)-1.0(4)	1.374(1)	-2.091(0)	2.836(-5)	-1.145(-9)	
		1.0(4)-1.0(5)	6.462(0)	-1.133(0)	1.434(-7)		
51	Antimony	1.0(0)-3.929(0) L3	1.429(1)	-2.224(0)	-4.615(-2)		
		3.929(0)-4.156(0) L2	1.573(1)	-2.606(0)			
		4.156(0)-4.465(0) L1	1.596(1)	-2.542(0)			
		4.465(0)-2.921(1) K	1.623(1)	-2.607(0)	-2.191(-3)		
		2.921(1)-1.0(2)	1.775(1)	-2.558(0)	-6.657(-4)		
		1.0(2)-1.0(3)	1.948(1)	-3.013(0)	1.330(-4)		
		1.0(3)-1.0(4)	1.377(1)	-2.082(0)	2.778(-5)	-1.116(-9)	
		1.0(4)-1.0(5)	6.533(0)	-1.130(0)	1.260(-7)		
52	Tellurium	1.0(0)-4.132(0) L3	1.437(1)	-2.235(0)	-4.050(-2)		
		4.132(0)-4.381(0) L2	1.569(1)	-2.525(0)			
		4.381(0)-4.698(0) L1	1.614(1)	-2.610(0)			
		4.698(0)-3.0491(1) K	1.631(1)	-2.610(0)	-2.031(-3)		
		3.0491(1)-1.0(2)	1.786(1)	-2.573(0)	-5.878(-4)		
		1.0(2)-1.0(3)	1.953(1)	-3.006(0)	1.327(-4)		
		1.0(3)-1.0(4)	1.406(1)	-2.112(0)	2.933(-5)	-1.184(-9)	
		1.0(4)-1.0(5)	7.299(0)	-1.208(0)	5.169(-7)	-2.167(-12)	
53	Iodine	1.0(0)-1.006(0) M1	1.438(1)	-1.910(0)			
		1.006(0)-4.341(0) L3	1.444(1)	-2.211(0)	-4.264(-2)		
		4.341(0)-4.612(0) L2	1.584(1)	-2.577(0)			
		4.612(0)-4.939(0) L1	1.618(1)	-2.590(0)			
		4.939(0)-3.1814(1) K	1.638(1)	-2.607(0)	-1.988(-3)		
		3.1814(1)-1.0(2)	1.797(1)	-2.586(0)	-5.313(-4)		
		1.0(2)-1.0(3)	1.952(1)	-2.988(0)	1.286(-4)		
		1.0(3)-1.0(4)	1.408(1)	-2.102(0)	2.866(-5)	-1.149(-9)	
		1.0(4)-1.0(5)	7.384(0)	-1.208(0)	5.119(-7)	-2.118(-12)	
54	Xenon	1.0(0)-1.072(0) M1	1.446(1)	-2.205(0)			
		1.072(0)-4.557(0) L3	1.451(1)	-2.204(0)	-4.239(-2)		
		4.557(0)-4.852(0) L2	1.599(1)	-2.619(0)			
		4.852(0)-5.188(0) L1	1.629(1)	-2.619(0)			
		5.188(0)-3.317(1) K	1.647(1)	-2.617(0)	-1.786(-3)		
		3.317(1)-1.0(2)	1.792(1)	-2.552(0)	-6.194(-4)		
		1.0(2)-1.0(3)	1.953(1)	-2.974(0)	1.256(-4)		
		1.0(3)-1.0(4)	1.413(1)	-2.096(0)	2.814(-5)	-1.122(-9)	
		1.0(4)-1.0(5)	7.385(0)	-1.199(0)	4.656(-7)	-1.884(-12)	
		1.0(0)-1.143(0) M1	1.454(1)	-2.225(0)			
		1.143(0)-4.782(0) L3	1.460(1)*	-2.246(0)	-3.399(-2)		
		4.782(0)-102(0) L2	1.617(1)	-2.687(0)			
		5.102(0)-5.445(0) L1	1.634(1)	-2.599(0)			
		5.445(0)-3.4561(1) K	1.637(1)	-2.493(0)	-7.112(-3)	9.647(-5)	
		3.4561(1)-1.0(2)	1.802(1)	-2.565(0)	-5.549(-4)		
		1.0(2)-1.0(3)	1.955(1)	-2.962(0)	1.228(-4)		
		1.0(3)-1.0(4)	1.424(1)	-2.099(0)	2.816(-5)	-1.118(-9)	
		1.0(4)-1.0(5)	6.963(0)	-1.141(0)	1.530(-7)		

TABLE I (Contd.)

Z	Element	Photon Energy Range, keV	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	P <sub>4</sub>	P <sub>5</sub>
55	Cesium	1.0(0)-1.065(0) M2	1.453(1)	-1.977(0)			
		1.065(0)-1.217(0) M1	1.460(1)	-2.156(0)			
		1.217(0)-5.012(0) L3	1.469(1)	-2.284(0)	-2.592(-2)		
		5.012(0)-5.360(0) L2	1.649(1)	-2.836(0)			
		5.360(0)-5.713(0) L1	1.639(1)	-2.586(0)			
		5.713(0)-3.5985(1) K	1.659(1)	-2.606(0)	-1.755(-3)		
		3.5985(1)-1.0(2)	1.800(1)	-2.541(0)	-5.897(-4)		
		1.0(2)-1.0(3)	1.959(1)	-2.955(0)	1.218(-4)		
		1.0(3)-1.0(4)	1.431(1)	-2.097(0)	2.769(-5)	-1.082(-9)	
		1.0(4)-1.0(5)	7.837(0)	-1.231(0)	6.110(-7)	-2.681(-12)	
56	Barium	1.0(0)-1.061(0) M3	1.446(1)	-1.978(0)			
		1.061(0)-1.135(0) M2	1.461(1)	-2.123(0)			
		1.135(0)-1.291(0) M1	1.467(1)	-2.120(0)			
		1.291(0)-5.247(0) L3	1.478(1)	-2.315(0)	-2.124(-2)		
		5.247(0)-5.623(0) L2	1.647(1)	-2.777(0)			
		5.623(0)-5.987(0) L1	1.661(1)	-2.672(0)			
		5.987(0)-3.7441(1) K	1.666(1)	-2.607(0)	-1.665(-3)		
		3.7441(1)-1.0(2)	1.801(1)	-2.527(0)	-5.915(-4)		
		1.0(2)-1.0(3)	1.965(1)	-2.951(0)	1.205(-4)		
		1.0(3)-1.0(4)	1.427(1)	-2.080(0)	2.688(-5)	-1.049(-9)	
		1.0(4)-1.0(5)	7.143(0)	-1.144(0)	1.561(-7)		
57	Lanthanum	1.0(0)-1.1240(0) M3	1.453(1)	-2.067(0)			
		1.1240(0)-1.2040(0) M2	1.469(1)	-2.190(0)			
		1.2040(0)-1.363(0) M1	1.475(1)	-2.163(0)			
		1.363(0)-5.484(0) L3	1.486(1)	-2.338(0)	-1.704(-2)		
		5.484(0)-5.891(0) L2	1.662(1)	-2.814(0)			
		5.891(0)-6.266(0) L1	1.679(1)	-2.733(0)			
		6.266(0)-3.8925(1) K	1.677(1)	-2.627(0)	-1.279(-3)		
		3.8925(1)-1.0(2)	1.809(1)	-2.534(0)	-5.590(-4)		
		1.0(2)-1.0(3)	1.969(1)	-2.946(0)	1.218(-4)		
		1.0(3)-1.0(4)	1.449(1)	-2.099(0)	2.754(-5)	-1.072(-9)	
		1.0(4)-1.0(5)	8.009(0)	-1.233(0)	6.078(-7)	-2.612(-12)	
58	Cerium	1.0(0)-1.185(0) M3	1.461(1)	-2.155(0)			
		1.185(0)-1.273(0) M2	1.478(1)	-2.311(0)			
		1.273(0)-1.435(0) M1	1.480(1)	-2.128(0)			
		1.435(0)-5.723(0) L3	1.493(1)	-2.340(0)	-1.609(-2)		
		5.723(0)-6.164(0) L2	1.678(1)	-2.863(0)			
		6.164(0)-6.549(0) L1	1.679(1)	-2.696(0)			
		6.549(0)-4.0443(1) K	1.684(1)	-2.620(0)	-1.163(-3)		
		4.0443(1)-1.0(2)	1.807(1)	-2.510(0)	-5.832(-4)		
		1.0(2)-1.0(3)	1.974(1)	-2.941(0)	1.214(-4)		
		1.0(3)-1.0(4)	1.453(1)	-2.093(0)	2.691(-5)	-1.036(-9)	
		1.0(4)-1.0(5)	8.149(0)	-1.240(0)	6.355(-7)	-2.752(-12)	
59	Praseodymium	1.0(0)-1.242(0) M3	1.469(1)	-2.243(0)			
		1.242(0)-1.337(0) M2	1.485(1)	-2.347(0)			
		1.337(0)-1.505(0) M1	1.488(1)	-2.190(0)			
		1.505(0)-5.964(0) L3	1.499(1)	-2.336(0)	-1.580(-2)		
		5.964(0)-6.44(0) L2	1.685(1)	-2.866(0)			
		6.44(0)-6.835(0) L1	1.697(1)	-2.751(0)			
		6.835(0)-4.1991(1) K	1.687(1)	-2.614(0)	-1.315(-3)		
		4.1991(1)-1.0(2)	1.808(1)	-2.497(0)	-5.907(-4)		
		1.0(2)-1.0(3)	1.979(1)	-2.937(0)	1.214(-4)		
		1.0(3)-1.0(4)	1.451(1)	-2.079(0)	2.622(-5)	-1.003(-9)	
		1.0(4)-1.0(5)	8.205(0)	-1.238(0)	6.238(-7)	-2.683(-12)	
60	Neodymium	1.001(0)-1.298(0) M3	1.477(1)	-2.313(0)			
		1.298(0)-1.403(0) M2	1.491(1)	-2.313(0)			
		1.403(0)-1.575(0) M1	1.494(1)	-2.208(0)			
		1.575(0)-6.208(0) L3	1.506(1)	-2.332(0)	-1.604(-2)		
		6.208(0)-6.722(0) L2	1.691(1)	-2.858(0)			
		6.722(0)-7.128(0) L1	1.713(1)	-2.802(0)			
		7.128(0)-4.3569(1) K	1.695(1)	-2.619(0)	-1.199(-3)		
		4.3569(1)-1.0(2)	1.880(1)	-2.697(0)			
		1.0(2)-1.0(3)	1.985(1)	-2.937(0)	1.241(-4)		
		1.0(3)-1.0(4)	1.474(1)	-2.102(0)	2.731(-5)	-1.059(-9)	
		1.0(4)-1.0(5)	7.482(0)	-1.149(0)	1.574(-7)		

TABLE I (Contd.)

Z	Element	Photon Energy Range, keV	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	P <sub>4</sub>	P <sub>5</sub>
61	Promethium	1.0(0)-1.027(0) M5	1.308(1)	-1.192(0)			
		1.027(0)-1.052(0) M4	1.440(1)	-2.004(0)			
		1.052(0)-1.357(0) M3	1.484(1)	-2.344(0)			
		1.357(0)-1.471(0) M2	1.498(1)	-2.323(0)			
		1.471(0)-1.648(0) M1	1.503(1)	-2.287(0)			
		1.648(0)-6.459(0) L3	1.512(1)	-2.332(0)	-1.552(-2)		
		6.459(0)-7.013(0) L2	1.696(1)	-2.844(0)			
		7.013(0)-7.428(0) L1	1.728(1)	-2.843(0)			
		7.428(0)-4.5184(1) K	1.698(1)	-2.607(0)	-1.239(-3)		
		4.5184(1)-1.0(2)	1.819(1)	-2.497(0)	-5.528(-4)		
		1.0(2)-1.0(3)	1.982(1)	-2.916(0)	1.171(-4)		
		1.0(3)-1.0(4)	1.470(1)	-2.084(0)	2.608(-5)	-9.878(-10)	
		1.0(4)-1.0(5)	7.585(0)	-1.152(0)	1.648(-7)		
62	Samarium	1.0(0)-1.078(0) M5	1.314(1)	-1.811(0)			
		1.078(0)-1.106(0) M4	1.441(1)	-1.463(0)			
		1.106(0)-1.419(0) M3	1.492(1)	-2.365(0)			
		1.419(0)-1.541(0) M2	1.503(1)	-2.274(0)			
		1.541(0)-1.723(0) M1	1.513(1)	-2.337(0)			
		1.723(0)-6.716(0) L3	1.519(1)	-2.341(0)	-1.440(-2)		
		6.716(0)-7.312(0) L2	1.718(1)	-2.920(0)			
		7.312(0)-7.736(0) L1	1.743(1)	-2.883(0)			
		7.736(0)-4.6834(1) K	1.704(1)	-2.607(0)	-1.193(-3)		
		4.6834(1)-1.0(2)	1.886(1)	-2.684(0)			
		1.0(2)-1.0(3)	1.987(1)	-2.913(0)	1.177(-4)		
		1.0(3)-1.0(4)	1.470(1)	-2.073(0)	2.542(-5)	-9.583(10)	
		1.0(4)-1.0(5)	7.678(0)	-1.155(0)	1.694(-7)		
63	Europium	1.0(0)-1.131(0) M5	1.323(1)	-2.073(0)			
		1.131(0)-1.161(0) M4	1.448(1)	-1.742(0)			
		1.161(0)-1.481(0) M3	1.499(1)	-2.386(0)			
		1.481(0)-1.614(0) M2	1.509(1)	-2.269(0)			
		1.614(0)-1.810(0) M1	1.523(1)	-2.405(0)			
		1.810(-6.977(0) L3	1.526(1)	-2.352(0)	-1.258(-2)		
		6.977(0)-7.618(0) L2	1.730(1)	-2.945(0)			
		7.618(0)-8.052(0) L1	1.755(1)	-2.906(0)			
		8.052(0)-4.85191(1) K	1.710(1)	-2.606(0)	-1.141(-3)		
		4.85191(1)-1.0(2)	1.891(1)	-2.683(0)			
		1.0(2)-1.0(3)	1.989(1)	-2.904(0)	1.171(-4)		
		1.0(3)-1.0(4)	1.478(1)	-2.074(0)	2.498(-5)	-9.217(-10)	
		1.0(4)-1.0(5)	8.496(0)	-1.239(0)	6.113(-7)	-2.591(-12)	
64	Gadolinium	1.0(0)-1.185(0) M5	1.329(1)	-2.030(0)			
		1.185(0)-1.217(0) M4	1.448(1)	-1.532(0)			
		1.217(0)-1.544(0) M3	1.507(1)	-2.416(0)			
		1.544(0)-1.688(0) M2	1.515(1)	-2.268(0)			
		1.688(0)-1.881(0) M1	1.527(1)	-2.364(0)			
		1.881(0)-7.243(0) L3	1.532(1)	-2.348(0)	-1.249(-2)		
		7.243(0)-7.930(0) L2	1.720(1)	-2.862(0)			
		7.930(0)-8.375(0) L1	1.766(1)	-2.924(0)			
		8.375(0)-5.02391(1) K	1.718(1)	-2.616(0)	-0.754(-4)		
		5.02391(1)-1.0(3)	1.883(1)	-2.637(0)	-2.283(-4)	4.371(-7)	-1.970(-10)
		1.0(3)-1.0(4)	1.483(1)	-2.070(0)	2.496(-5)	-9.289(-10)	
		1.0(4)-1.0(5)	8.564(0)	-1.239(0)	6.040(-7)	-2.534(-12)	
65	Terbium	1.0(0)-1.241(0) M5	1.335(1)	-2.054(0)			
		1.24(0)-1.274(0) M4	1.458(1)	-1.829(0)			
		1.274(0)-1.610(0) M3	1.514(1)	-2.444(0)			
		1.610(0)-1.765(0) M2	1.527(1)	-2.369(0)			
		1.765(0)-1.963(0) M1	1.535(1)	-2.390(0)			
		1.963(0)-7.514(0) L3	1.539(1)	-2.362(0)	-1.109(-2)		
		7.514(0)-8.252(0) L2	1.738(1)	-2.917(0)			
		8.252(0)-8.708(0) L1	1.770(1)	-2.907(0)			
		8.708(0)-5.1996(1) K	1.721(1)	-2.605(0)	-0.941(-4)		
		5.1996(1)-1.0(3)	1.880(1)	-2.613(0)	-2.706(-4)	5.058(-7)	-2.323(-10)
		1.0(3)-1.0(4)	1.491(1)	-2.073(0)	2.511(-5)	-9.442(-10)	
		1.0(4)-1.0(5)	8.592(0)	-1.235(0)	5.960(-7)	-2.532(-12)	
66	Dysprosium	1.0(0)-1.295(0) M5	1.342(1)	-2.071(0)			
		1.295(0)-1.332(0) M4	1.462(1)	-1.821(0)			
		1.332(0)-1.676(0) M3	1.521(1)	-2.447(0)			

TABLE I (Contd.)

Z	Element	Photon Energy Range, keV	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	P <sub>4</sub>	P <sub>5</sub>
66	Dysprosium (Contd.)	1.676(0)-1.842(0) M2	1.529(1)	-2.303(0)			
		1.842(0)-2.046(0) M1	1.539(1)	-2.364(0)			
		2.046(0)-7.790(1) L3	1.545(1)	-2.368(0)	-1.053(-2)		
		7.790(0)-8.580(0) L2	1.730(1)	-2.847(0)			
		8.580(0)-9.046(0) L1	1.764(1)	-2.852(0)			
		9.046(0)-5.3788(1) K	1.727(1)	-2.604(0)	-9.540(-4)		
		5.3788(1)-1.0(3)	1.884(1)	-2.609(0)	-2.6771(-4)	4.993(-7)	-2.277(-10)
		1.0(3)-1.0(4)	1.516(1)	-2.099(0)	2.6491(-5)	-1.011(-9)	
		1.0(4)-1.0(5)	8.784(0)	-1.249(0)	6.6471(-7)	-2.923(-12)	
67	Holmium	1.00(0)-1.351(0) M5	1.349(1)	-2.099(0)			
		1.351(0)-1.392(0) M4	1.457(1)	-1.532(0)			
		1.392(0)-1.743(0) M3	1.527(1)	-2.431(0)			
		1.743(0)-1.923(0) M2	1.540(1)	-2.390(0)			
		1.923(0)-2.13(0) M1	1.548(1)	-2.412(0)			
		2.13(0)-8.072(0) L3	1.551(1)	-2.366(0)	-1.055(-2)		
		8.072(0)-8.918(0) L2	1.742(1)	-2.872(0)			
		8.918(0)-9.394(0) L1	1.782(1)	-2.904(0)			
		9.394(0)-5.5618(1) K	1.731(1)	-2.600(0)	-9.414(-4)		
		5.5618(1)-1.0(3)	1.887(1)	-2.605(0)	-2.6131(-4)	4.934(-7)	-2.275(-10)
		1.0(3)-1.0(4)	1.513(1)	-2.084(0)	2.5561(-5)	-9.666(-10)	
		1.0(4)-1.0(5)	8.727(0)	-1.235(0)	5.8301(-7)	-2.441(-12)	
68	Erbium	1.00(0)-1.409(0) M5	1.356(1)	-2.106(0)			
		1.409(0)-1.453(0) M4	1.451(1)	-1.296(0)			
		1.453(0)-1.812(0) M3	1.533(1)	-2.426(0)			
		1.812(0)-2.006(0) M2	1.552(1)	-2.499(0)			
		2.006(0)-2.217(0) M1	1.554(1)	-2.425(0)			
		2.217(0)-8.3581(0) L3	1.555(1)	-2.351(0)	-1.139(-2)		
		8.358(0)-9.264(0) L2	1.748(1)	-2.869(0)			
		9.264(0)-9.752(0) L1	1.785(1)	-2.886(0)			
		9.752(0)-5.7486(1) K	1.734(1)	-2.590(0)	-9.7571(-4)		
		5.7486(1)-1.0(3)	1.891(1)	-2.603(0)	-2.4601(-4)	4.6521(-7)	-2.128(-10)
		1.0(3)-1.0(4)	1.510(1)	-2.069(0)	2.4651(-5)	-9.210(-10)	
		1.0(4)-1.0(5)	8.866(0)	-1.244(0)	6.3801(-7)	-2.819(-12)	
69	Thulium	1.00(0)-1.468(0) M5	1.362(1)	-2.104(0)			
		1.468(0)-1.515(0) M4	1.452(1)	-1.289(0)			
		1.515(0)-1.881(0) M3	1.539(1)	-2.450(0)			
		1.881(0)-2.090(0) M2	1.558(1)	-2.497(0)			
		2.090(0)-2.306(0) M1	1.562(1)	-2.454(0)			
		2.306(0)-8.648(0) L3	1.560(1)	-2.347(0)	-1.1271(-2)		
		8.648(0)-9.617(0) L2	1.753(1)	-2.865(0)			
		9.617(0)-1.0161(1) L1	1.798(1)	-2.915(0)			
		1.0161(0)-5.9391(1) K	1.741(1)	-2.595(0)	-9.2421(-4)		
		5.9391(1)-1.0(3)	1.896(1)	-2.603(0)	-2.3061(-4)	4.3791(-7)	-1.978(-10)
		1.0(3)-1.0(4)	1.522(1)	-2.077(0)	2.4961(-5)	-9.351(-10)	
		1.0(4)-1.0(5)	8.861(0)	-1.236(0)	5.9881(-7)	-2.5901(-12)	
70	Ytterbium	1.00(0)-1.528(0) M5	1.369(1)	-2.095(0)			
		1.528(0)-1.577(0) M4	1.468(1)	-1.639(0)			
		1.577(0)-1.950(0) M3	1.545(1)	-2.448(0)			
		1.950(0)-2.175(0) M2	1.563(1)	-2.488(0)			
		2.175(0)-2.3981(0) M1	1.565(1)	-2.427(0)			
		2.398(0)-8.943(0) L3	1.565(1)	-2.346(0)	-1.091(-2)		
		8.943(0)-9.978(0) L2	1.757(1)	-2.857(0)			
		9.978(0)-1.04891(1) L1	1.793(1)	-2.865(0)			
		1.04891(0)-6.1332(1) K	1.747(1)	-2.595(0)	-8.6701(-4)		
		6.1332(1)-1.0(3)	1.894(1)	-2.587(0)	-2.5151(-4)	4.7821(-7)	-2.209(-10)
		1.0(3)-1.0(4)	1.539(1)	-2.092(0)	2.5741(-5)	-9.7771(-10)	
		1.0(4)-1.0(5)	8.990(0)	-1.244(0)	6.3521(-7)	-2.7731(-12)	
71	Lutetium	1.00(0)-1.591(0) M5	1.375(1)	-2.088(0)			
		1.591(0)-1.641(0) M4	1.476(1)	-1.747(0)			
		1.641(0)-2.024(0) M3	1.549(1)	-2.425(0)			
		2.024(0)-2.264(0) M2	1.571(1)	-2.520(0)			
		2.264(0)-2.494(0) M1	1.569(1)	-2.406(0)			
		2.494(0)-9.245(0) L3	1.570(1)	-2.344(0)	-1.0571(-2)		
		9.245(0)-1.03491(0) L2	1.765(1)	-2.867(0)			
		1.03491(0)-1.08741(1) L1	1.803(1)	-2.880(0)			
		1.08741(0)-6.3316(1) K	1.752(1)	-2.594(0)	-8.245(-4)		

TABLE I (Contd.)

Z	Element	Photon Energy Range, keV	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	P <sub>4</sub>	P <sub>5</sub>
71 (Contd.)	Lutetium	6.3316(1)-1.0(3)	1.902(1)	-2.593(0)	-2.391(-4)	4.694(-7)	-2.209(-10)
		1.0(3)-1.0(4)	1.535(1)	-2.078(0)	2.497(-5)	-9.427(-10)	
		1.0(4)-1.0(5)	9.138(0)	-1.254(0)	6.865(-7)	-3.067(-12)	
72	Hafnium	1.0(0)-1.662(0) M5	1.381(1)	-2.071(0)			
		1.662(0)-1.716(0) M4	1.480(1)	-1.771(0)			
		1.716(0)-2.108(0) M3	1.554(1)	-2.410(0)			
		2.108(0)-2.364(0) M2	1.572(1)	-2.456(0)			
		2.364(0)-2.610(0) M1	1.576(1)	-2.421(0)			
		2.610(-9.561(0) L3	1.576(1)	-2.349(0)	-1.015(-2)		
		9.561(0)-1.07391(1) L2	1.759(1)	-2.815(0)			
		1.07391(1)-1.12721(1) L1	1.798(1)	-2.834(0)			
		1.12721(1)-6.5345(1) K	1.760(1)	-2.606(0)	-7.227(-4)		
		6.5345(1)-1.0(3)	1.899(1)	-2.576(0)	-2.466(-4)	4.657(-7)	-2.142(-10)
73	Tantalum	1.0(3)-1.0(4)	1.539(1)	-2.074(0)	2.462(-5)	-9.170(-10)	
		1.0(4)-1.0(5)	9.177(0)	-1.251(0)	6.571(-7)	-2.897(-12)	
		1.0(0)-1.735(0) M5	1.387(1)	-2.053(0)			
		1.735(0)-1.1793(0) M4	1.490(1)	-1.882(0)			
		1.793(0)-2.1940(0) M3	1.560(1)	-2.403(0)			
		2.194(0)-2.469(0) M2	1.584(1)	-2.517(0)			
		2.469(0)-2.709(0) M1	1.587(1)	-2.477(0)			
		2.709(0)-9.881(0) L3	1.583(1)	-2.363(0)	-9.095(-3)		
		9.881(0)-1.11361(1) L2	1.772(1)	-2.841(0)			
		1.11361(1)-1.1681(1) L1	1.816(1)	-2.882(0)			
74	Tungsten	1.1681(1)-6.74161(1) K	1.762(1)	-2.593(0)	-7.577(-4)		
		6.74161(1)-1.0(3)	1.905(1)	-2.581(0)	-2.256(-4)	4.380(-7)	-2.022(-10)
		1.0(3)-1.0(4)	1.561(1)	-2.099(0)	2.620(-5)	-1.011(-9)	
		1.0(4)-1.0(5)	9.289(0)	-1.258(0)	7.105(-7)	-3.226(-12)	
		1.0(0)-1.809(0) M5	1.392(1)	-2.038(0)			
		1.809(0)-1.871(0) M4	1.496(1)	-1.931(0)			
		1.871(0)-2.281(0) M3	1.563(1)	-2.377(0)			
		2.281(0)-2.575(0) M2	1.591(1)	-2.532(0)			
		2.575(0)-2.820(0) M1	1.591(1)	-2.459(0)			
		2.820(0)-1.0204(1) L3	1.589(1)	-2.364(0)	-9.293(-3)		
75	Rhenium	1.0204(1)-1.1541(1) L2	1.772(1)	-2.820(0)			
		1.1541(1)-1.20981(1) L1	1.773(1)	-2.685(0)			
		1.20981(1)-6.95251(1) K	1.769(1)	-2.603(0)	-6.647(-4)		
		6.95251(1)-1.0(3)	1.905(1)	-2.569(0)	-2.265(-4)	4.263(-7)	-1.919(-10)
		1.0(3)-1.0(4)	1.579(1)	-2.116(0)	2.752(-5)	-1.095(-9)	
		1.0(4)-1.0(5)	9.254(1)	-1.247(0)	6.411(-7)	-2.788(-12)	
		1.0(0)-1.883(0) M5	1.399(1)	-2.041(0)			
		1.883(0)-1.950(0) M4	1.512(1)	-2.129(0)			
		1.950(0)-2.368(0) M3	1.564(1)	-2.329(0)			
		2.368(0)-2.682(0) M2	1.595(1)	-2.506(0)			
76	Osmium	2.682(0)-2.934(0) M1	1.593(1)	-2.422(0)			
		2.934(0)-1.0534(1) L3	1.596(1)	-2.381(0)	-8.069(-3)		
		1.0534(1)-1.19571(1) L2	1.779(1)	-2.827(0)			
		1.1957(1)-1.25281(1) L1	1.778(1)	-2.686(0)			
		1.25281(1)-7.16761(1) K	1.774(1)	-2.600(0)	-6.573(-4)		
		7.16761(1)-1.0(3)	1.952(1)	-2.689(0)	1.273(-5)	5.375(-8)	
		1.0(3)-1.0(4)	1.567(1)	-2.088(0)	2.532(-5)	-9.577(-10)	
		1.0(4)-1.0(5)	9.388(0)	-1.255(0)	6.714(-7)	-2.998(-12)	
		1.0(0)-1.961(0) M5	1.405(1)	-2.038(0)			
		1.96(0)-2.031(0) M4	1.522(1)	-2.209(0)			
77	Iridium	2.031(0)-2.457(0) M3	1.569(1)	-2.331(0)			
		2.457(0)-2.792(0) M2	1.596(1)	-2.466(0)			
		2.792(0)-3.052(0) M1	1.597(1)	-2.415(0)			
		3.052(0)-1.0871(1) L3	1.601(1)	-2.383(0)	-7.777(-3)		
		1.0871(1)-1.2385(1) L2	1.782(1)	-2.816(0)			
		1.2385(1)-1.29691(1) L1	1.788(1)	-2.702(0)			
		1.29691(1)-7.3871(1) K	1.779(1)	-2.601(0)	-6.010(-4)		
		7.3871(1)-1.0(3)	1.905(1)	-2.547(0)	-2.343(-4)	4.327(-7)	-1.940(-10)
		1.0(3)-1.0(4)	1.571(1)	-2.084(0)	2.495(-5)	-9.362(-10)	
		1.0(4)-1.0(5)	9.529(0)	-1.264(0)	7.123(-7)	-3.227(-12)	
		1.0(0)-2.04(0) M5	1.409(1)	-1.742(0)	-1.456(-1)		
		2.04(0)-2.116(0) M4	1.528(1)	-2.224(0)			
		2.116(0)-2.551(0) M3	1.577(1)	-2.366(0)			

TABLE I (Contd.)

Z	Element	Photon Energy Range, keV	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	P <sub>4</sub>	P <sub>5</sub>
77 (Contd.)	Iridium	2.551(0)-2.908(0) M2	1.600(1)	-2.454(0)			
		2.908(0)-3.173(0) M1	1.600(1)	-2.392(0)			
		3.173(0)-1.1215(1) L3	1.608(1)	-2.399(0)	-6.758(-3)		
		1.1215(1)-1.2824(1) L2	1.794(1)	-2.840(0)			
		1.2824(1)-1.3419(1) L1	1.763(1)	-2.588(0)			
		1.3419(1)-7.6111(1) K	1.781(1)	-2.592(0)	-6.171(-4)		
		7.6111(1)-1.0(3)	1.904(1)	-2.534(0)	-2.460(-4)	4.546(-7)	-2.072(-10)
		1.0(3)-1.0(4)	1.573(1)	-2.080(0)	2.460(-5)	-9.109(-10)	
		1.0(4)-1.0(5)	9.628(0)	-1.269(0)	7.189(-7)	-3.228(-12)	
78	Platinum	1.0(0)-2.122(0) M5	1.415(1)	-1.767(0)	-1.314(-1)		
		2.122(0)-2.202(0) M4	1.538(1)	-2.296(0)			
		2.202(0)-2.645(0) M3	1.584(1)	-2.383(0)			
		2.645(0)-3.027(0) M2	1.604(1)	-2.445(0)			
		3.027(0)-3.297(0) M1	1.606(1)	-2.400(0)			
		3.297(0)-1.1564(1) L3	1.614(1)	-2.407(0)	-6.269(-3)		
		1.1564(1)-1.3273(1) L2	1.786(1)	-2.784(0)			
		1.3273(1)-1.388(1) L1	1.757(1)	-2.546(0)			
		1.388(1)-7.8395(1) K	1.788(1)	-2.599(0)	-5.394(-4)		
		7.8395(1)-1.0(3)	1.913(1)	-2.545(0)	-2.218(-4)	4.175(-7)	-1.882(-10)
79	Gold	1.0(3)-1.0(4)	1.587(1)	-2.092(0)	2.526(-5)	-9.440(-10)	
		1.0(4)-1.0(5)	9.757(0)	-1.277(0)	7.765(-7)	-3.621(-12)	
		1.0(0)-2.206(0) M5	1.422(1)	-1.826(0)	-1.065(-1)		
		2.206(0)-2.291(0) M4	1.541(1)	-2.284(0)			
		2.291(0)-2.743(0) M3	1.586(1)	-2.357(0)			
		2.743(0)-3.15(0) M2	1.603(1)	-2.387(0)			
		3.15(0)-3.425(0) M1	1.612(1)	-2.417(0)			
		3.425(0)-1.1919(1) L3	1.620(1)	-2.421(0)	-5.201(-3)		
		1.1919(1)-1.3734(1) L2	1.774(1)	-2.722(0)			
80	Mercury	1.3734(1)-1.4353(1) L1	1.792(1)	-2.662(0)			
		1.4353(1)-8.0725(1) K	1.795(1)	-2.607(0)	-4.657(-4)		
		8.0725(1)-1.0(3)	1.908(1)	-2.524(0)	-2.376(-4)	4.367(-7)	-1.974(-10)
		1.0(3)-1.0(4)	1.595(1)	-2.095(0)	2.551(-5)	-9.464(-10)	
		1.0(4)-1.0(5)	9.725(0)	-1.267(0)	7.124(-7)	-3.185(-12)	
		1.0(0)-2.295(0) M5	1.427(1)	-1.784(0)	-1.217(-1)		
		2.295(0)-2.385(0) M4	1.560(1)	-2.444(0)			
		2.385(0)-2.847(0) M3	1.586(1)	-2.320(0)			
		2.847(0)-3.28(0) M2	1.604(1)	-2.355(0)			
81	Thallium	3.28(0)-3.562(0) M1	1.617(1)	-2.415(0)			
		3.562(0)-1.2283(1) L3	1.624(1)	-2.456(0)	-5.456(-3)		
		1.2283(1)-1.4209(1) L2	1.785(1)	-2.742(0)			
		1.4209(1)-1.4842(1) L1	1.755(1)	-2.504(0)			
		1.4842(1)-8.3102(1) K	1.798(1)	-2.599(0)	-4.941(-4)		
		8.3102(1)-1.0(3)	1.909(1)	-2.519(0)	-2.355(-4)	4.419(-7)	-2.028(-10)
		1.0(3)-1.0(4)	1.590(1)	-2.078(0)	2.422(-5)	-8.900(-10)	
		1.0(4)-1.0(5)	9.826(0)	-1.272(0)	7.431(-7)	-3.442(-12)	
		1.0(0)-2.389(0) M5	1.443(1)	-1.787(0)	-1.175(-1)		
82	Lead	2.389(0)-2.485(0) M4	1.566(1)	-2.453(0)			
		2.485(0)-2.956(0) M3	1.600(1)	-2.409(0)			
		2.956(0)-3.416(0) M2	1.614(1)	-2.398(0)			
		3.416(0)-3.704(0) M1	1.622(1)	-2.419(0)			
		3.704(0)-1.2656(1) L3	1.629(1)	-2.418(0)	-4.807(-3)		
		1.2656(1)-1.4697(1) L2	1.797(1)	-2.768(0)			
		1.4697(1)-1.5346(1) L1	1.739(1)	-2.427(0)			
		1.5346(1)-8.553(1) K	1.803(1)	-2.600(0)	-4.664(-4)		
		8.553(1)-1.0(3)	1.910(1)	-2.512(0)	-2.279(-4)	4.195(-7)	-1.881(-10)
		1.0(3)-1.0(4)	1.605(1)	-2.092(0)	2.510(-5)	-9.454(-10)	
		1.0(4)-1.0(5)	9.869(0)	-1.272(0)	7.466(-7)	-3.441(-12)	

TABLE I (Contd.)

Z	Element	Photon Energy Range, keV	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	P <sub>4</sub>	P <sub>5</sub>
82	Lead	8.8004(1)-1.0(3)	1.917(1)	-2.518(0)	-2.075(-4)	3.902(-7)	-1.750(-10)
		1.0(3)-1.0(4)	1.786(1)	-2.371(0)	5.551(-5)	-5.008(-9)	1.915(-12)
		1.0(4)-1.0(5)	9.962(0)	-1.276(0)	7.810(-7)	-3.693(-12)	
83	Bismuth	1.0(0)-2.581(0) M5	1.444(1)	-1.781(0)	-1.166(-1)		
		2.581(0)-2.689(0) M4	1.580(1)	-2.484(0)			
		2.689(0)-3.177(0) M3	1.613(1)	-2.439(0)			
		3.177(0)-3.696(0) M2	1.630(1)	-2.457(0)			
		3.696(0)-4.0(0) M1	1.634(1)	-2.440(0)			
		1.0(0)-1.342(1) L3	1.640(1)	-2.435(0)	-3.805(-3)		
		1.342(1)-1.571(1) L2	1.802(1)	-2.752(0)			
		1.571(1)-1.639(1) L1	1.761(1)	-2.481(0)			
		1.639(1)-9.0526(1) K	1.808(1)	-2.588(0)	-4.590(-4)		
		9.0526(1)-1.0(3)	1.924(1)	-2.526(0)	-1.973(-4)	3.865(-7)	-1.760(-10)
		1.0(3)-1.0(4)	1.777(1)	-2.349(0)	5.342(-5)	-4.781(-9)	1.834(-13)
		1.0(4)-1.0(5)	1.003(1)	-1.278(0)	7.616(-7)	-3.521(-12)	
84	Polonium	1.0(0)-2.683(0) M5	1.450(1)	-1.838(0)	-9.401(-2)		
		2.683(0)-2.798(0) M4	1.583(1)	-2.455(0)			
		2.798(0)-3.295(0) M3	1.621(1)	-2.464(0)			
		3.295(0)-3.849(0) M2	1.635(1)	-2.454(0)			
		3.849(0)-4.156(0) M1	1.645(1)	-2.488(0)			
		4.156(0)-1.3814(1) L3	1.645(1)	-2.437(0)	-3.622(-3)		
		1.3814(1)-1.6244(1) L2	1.799(1)	-2.722(0)			
		1.6244(1)-1.6936(1) L1	1.752(1)	-2.434(0)			
		1.6936(1)-9.3105(1) K	1.813(1)	-2.587(0)	-4.360(-4)		
		9.3105(1)-1.0(3)	1.916(1)	-2.497(0)	-2.177(-4)	4.040(-7)	-1.820(-10)
		1.0(3)-1.0(4)	1.630(1)	-2.106(0)	2.580(-5)	-9.809(-10)	
		1.0(4)-1.0(5)	9.972(0)	-1.266(0)	7.175(-7)	-3.307(-12)	
85	Astatine	1.0(0)-1.042(0) N1	1.453(1)	-2.115(0)			
		1.042(0)-2.787(0) M5	1.455(1)	-1.794(0)	-1.049(-1)		
		2.787(0)-2.909(0) M4	1.598(1)	-2.545(0)			
		2.909(0)-3.416(0) M3	1.626(1)	-2.461(0)			
		3.416(0)-4.006(0) M2	1.642(1)	-2.468(0)			
		4.006(0)-4.317(0) M1	1.646(1)	-2.462(0)			
		4.317(0)-1.4241(1) L3	1.652(1)	-2.454(0)	-2.757(-3)		
		1.4241(1)-1.6785(1) L2	1.810(1)	-2.745(0)			
		1.6785(1)-1.7491(1) L1	1.775(1)	-2.500(0)			
		1.7491(1)-9.573(1) K	1.819(1)	-2.594(0)	-3.756(-4)		
		9.573(1)-1.0(3)	1.929(1)	-2.522(0)	-1.765(-4)	3.513(-7)	-1.558(-10)
		1.0(3)-1.0(4)	1.644(1)	-2.118(0)	2.632(-5)	-1.011(-9)	
		1.0(4)-1.0(5)	1.010(1)	-1.274(0)	7.556(-7)	-3.581(-12)	
86	Radon	1.0(0)-1.095(1) N1	1.458(1)	-2.019(0)			
		1.095(0)-2.892(0) M5	1.460(1)	-1.814(0)	-9.406(-2)		
		2.892(0)-3.022(0) M4	1.599(1)	-2.506(0)			
		3.022(0)-3.538(0) M3	1.635(1)	-2.493(0)			
		3.538(0)-4.164(0) M2	1.644(1)	-2.448(0)			
		4.164(0)-4.482(0) M1	1.654(1)	-2.484(0)			
		4.482(0)-1.4619(1) L3	1.656(1)	-2.448(0)			
		1.4619(1)-1.7337(1) L2	1.811(1)	-2.731(0)	-3.051(-3)		
		1.7337(1)-1.8055(1) L1	1.777(1)	-2.494(0)			
		1.8055(1)-9.8404(1) K	1.820(1)	-2.582(0)	-3.973(-4)		
		9.8404(1)-1.0(3)	1.921(1)	-2.495(0)	-1.920(-4)	3.595(-7)	-1.566(-10)
		1.0(3)-1.0(4)	1.805(1)	-2.365(0)	5.290(-5)	-4.549(-9)	1.665(-13)
		1.0(4)-1.0(5)	1.009(1)	-1.268(0)	7.444(-7)	-3.546(-12)	
87	Francium	1.0(0)-1.15(0) N1	1.463(1)	-1.954(0)			
		1.15(0)-3.0(0) M5	1.465(1)	-1.829(0)	-8.677(-2)		
		3.0(0)-3.136(0) M4	1.604(1)	-2.500(0)			
		3.136(0)-3.664(0) M3	1.638(1)	-2.476(0)			
		3.664(0)-4.325(0) M2	1.653(1)	-2.480(0)			
		4.325(0)-4.652(0) M1	1.654(1)	-2.450(0)			
		4.652(0)-1.503(1) L3	1.663(1)	-2.469(0)	-2.188(-3)		
		1.503(1)-1.7904(1) L2	1.821(1)	-2.751(0)			
		1.7904(1)-1.8639(1) L1	1.776(1)	-2.474(0)			
		1.8639(1)-1.01137(2) K	1.822(1)	-2.579(0)	-3.866(-4)		
		1.01137(2)-1.0(3)	1.918(1)	-2.479(0)	-2.189(-4)	4.154(-7)	-1.895(-10)
		1.0(3)-1.0(4)	1.783(1)	-2.321(0)	4.818(-5)	-4.037(-9)	1.475(-13)
		1.0(4)-1.0(5)	1.161(1)	-1.440(0)	2.278(-6)	-2.429(-10)	9.938(-17)

TABLE I (Contd.)

Z	Element	Photon Energy Range, keV	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	P <sub>4</sub>	P <sub>5</sub>
88	Radium	1.0(0)-1.208(0) N1	1.468(1)	-1.916(0)			
		1.208(0)-3.109(0) M5	1.470(1)	-1.848(0)	-8.060(-2)		
		3.109(0)-3.253(0) M4	1.619(1)	-2.587(0)			
		3.253(0)-3.791(0) M3	1.643(1)	-2.482(0)			
		3.791(0)-4.491(0) M2	1.659(1)	-2.490(0)			
		4.491(0)-4.824(0) M1	1.659(1)	-2.451(0)			
		4.824(0)-1.5446(1) L3	1.667(1)	-2.458(0)	-2.774(-3)		
		1.5446(1)-1.8484(1) L2	1.826(1)	-2.751(0)			
		1.8484(1)-1.9237(1) L1	1.775(1)	-2.460(0)			
		1.9237(1)-1.03922(2) K	1.830(1)	-2.589(0)	-3.262(-4)		
		1.03922(2)-1.0(3)	1.904(1)	-2.434(0)	-2.770(-4)	4.904(-7)	-2.232(-10)
		1.0(3)-1.0(4)	1.821(1)	-2.374(0)	5.400(-5)	-4.752(-9)	1.782(-13)
		1.0(4)-1.0(5)	1.028(1)	-1.279(0)	8.044(-7)	-3.948(-12)	
89	Actinium	1.0(0)-1.269(0) N1	1.472(1)	-1.919(0)			
		1.269(0)-3.219(0) M5	1.477(1)	-1.951(0)	-5.184(-2)		
		3.219(0)-3.371(0) M4	1.615(1)	-2.508(0)			
		3.371(0)-3.918(0) M3	1.649(1)	-2.495(0)			
		3.918(0)-4.658(0) M2	1.665(1)	-2.503(0)			
		4.658(0)-5.002(0) M1	1.660(1)	-2.435(0)			
		5.002(0)-1.587(1) L3	1.670(1)	-2.455(0)	-2.836(-3)		
		1.587(1)-1.9083(1) L2	1.826(1)	-2.736(0)			
		1.9083(1)-1.9845(1) L1	1.780(1)	-2.463(0)			
		1.9845(1)-1.06759(2) K	1.830(1)	-2.578(0)	-3.358(-4)		
90	Thorium	1.06759(2)-1.0(3)	1.922(1)	-2.471(0)	-2.068(-4)	3.870(-7)	-1.726(-10)
		1.0(3)-1.0(4)	1.820(1)	-2.365(0)	5.364(-5)	-4.760(-9)	1.805(-13)
		1.0(4)-1.0(5)	1.178(1)	-1.448(0)	2.240(-6)	-2.312(-11)	9.178(-17)
91	Proactinium	1.0(0)-1.330(0) N1	1.477(1)	-1.915(0)			
		1.330(0)-3.332(0) M5	1.482(1)	-1.957(0)	-4.990(-2)		
		3.332(0)-3.494(0) M4	1.636(1)	-2.639(0)			
		3.494(0)-4.046(0) M3	1.657(1)	-2.524(0)			
		4.046(0)-4.831(0) M2	1.669(1)	-2.497(0)			
		4.831(0)-5.182(0) M1	1.659(1)	-2.399(0)			
		5.182(0)-1.631(1) L3	1.678(1)	-2.472(0)	-2.296(-3)		
		1.631(1)-1.9693(1) L2	1.833(1)	-2.745(0)			
		1.9693(1)-2.0466(1) L1	1.783(1)	-2.459(0)			
		2.0466(1)-1.09651(2) K	1.831(1)	-2.565(0)	-3.730(-4)		
		1.09651(2)-1.0(3)	2.002(1)	-2.658(0)	6.966(-5)	1.726(-8)	
		1.0(3)-1.0(4)	1.811(1)	-2.341(0)	5.026(-5)	-4.249(-9)	-1.549(-13)
		1.0(4)-1.0(5)	1.053(1)	-1.294(0)	8.555(-7)	-4.161(-12)	
92	Uranium	1.0(0)-1.385(0) N1	1.472(1)	-1.648(0)			
		1.385(0)-3.442(0) M5	1.488(1)	-2.010(0)	-3.621(-2)		
		3.442(0)-3.609(0) M4	1.640(1)	-2.636(0)			
		3.609(0)-4.174(0) M3	1.665(1)	-2.550(0)			
		4.174(0)-5.003(0) M2	1.668(1)	-2.464(0)			
		5.003(0)-5.364(0) M1	1.663(1)	-2.398(0)			
		5.364(0)-1.6733(1) L3	1.685(1)	-2.499(0)	-1.409(-3)		
		1.6733(1)-2.0314(1) L2	1.834(1)	-2.731(0)			
		2.0314(1)-2.1105(1) L1	1.796(1)	-2.489(0)			
		2.1105(1)-1.12601(2) K	1.841(1)	-2.585(0)	-2.702(-4)		
93	Neptunium	1.12601(2)-1.0(3)	1.927(1)	-2.469(0)	-1.854(-4)	3.538(-7)	-1.567(-10)
		1.0(3)-1.0(4)	1.821(1)	-2.350(0)	5.117(-5)	-4.346(-9)	1.577(-13)
		1.0(4)-1.0(5)	1.039(1)	-1.274(0)	7.667(-7)	-3.683(-12)	

TABLE I (Contd.)

Z	Element	Photon Energy Range, keV	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	P <sub>4</sub>	P <sub>5</sub>
93	Neptunium	1.0(0)-1.501(0) N1 1.564(0)-3.664(0) M5 3.664(0)-3.851(0) M4 3.851(0)-4.435(0) M3 4.435(0)-5.366(0) M2 5.366(0)-5.735(0) M1 5.735(0)-1.7613(1) L3 1.7613(1)-2.161(1) L2 2.161(1)-2.2427(1) L1 2.2427(1)-1.1867(2) K 1.1867(2)-1.0(3) 1.0(3)-1.0(4) 1.0(4)-1.0(5)	1.460(1) 1.503(1) 1.637(1) 1.668(1) 1.681(1) 1.686(1) 1.699(1) 1.836(1) 1.846(1) 1.999(1) 1.830(1) 1.059(1)	-1.203(0) -2.180(0) -2.539(0) -2.510(0) -2.493(0) -2.491(0) -2.537(0) -2.711(0) -2.576(0) -2.628(0) -2.346(0) -1.286(0)	-2.580(-4) 6.271(-5) 4.938(-5) -4.073(-9) 8.179(-7)	1.998(-8) -4.073(-9) 1.455(-13)	
94	Plutonium	1.0(0)-1.562(0) N1 1.562(0)-3.778(0) M5 3.778(0)-3.973(0) M4 3.973(0)-4.568(0) M3 4.568(0)-5.555(0) M2 5.555(0)-5.927(0) M1 5.927(0)-1.8063(1) L3 1.8063(1)-2.227(1) L2 2.227(1)-2.3109(1) L1 2.3109(1)-1.21797(2) K 1.21797(2)-1.0(3) 1.0(3)-1.0(4) 1.0(4)-1.0(5)	1.485(1) 1.508(1) 1.660(1) 1.676(1) 1.683(1) 1.702(1) 1.704(1) 1.839(1) 1.844(1) 1.989(1) 1.692(1) 1.060(1)	-1.717(0) -2.193(0) -2.678(0) -2.537(0) -2.479(0) -2.554(0) -2.540(0) -2.705(0) -2.461(0) -2.600(0) -2.121(0) -1.281(0)	-3.162(-4) 5.541(-5) 2.566(-5) 7.834(-7)	2.025(-8) -9.619(-10) -3.687(-12)	
95	Americium	1.0(0)-1.625(0) N1 1.625(0)-3.894(0) M5 3.894(0)-4.110(0) M4 4.110(0)-4.703(0) M3 4.703(0)-5.748(0) M2 5.748(0)-6.122(0) M1 6.122(0)-1.8519(1) L3 1.8519(1)-2.2958(1) L2 2.2958(1)-2.3812(1) L1 2.3812(1)-1.2499(2) K 1.2499(2)-1.0(3) 1.0(3)-1.0(4) 1.0(4)-1.0(5)	1.489(1) 1.514(1) 1.662(1) 1.670(1) 1.680(1) 1.708(1) 1.707(1) 1.843(1) 1.846(1) 1.850(1) 1.990(1) 1.831(1) 1.066(1)	-1.737(0) -2.209(0) -2.659(0) -2.468(0) -2.437(0) -2.566(0) -2.535(0) -2.707(0) -2.603(0) -2.561(0) -2.594(0) -2.333(0) -1.283(0)	-2.667(-4) 5.522(-5) 4.807(-5) 7.734(-7)	2.058(-8) -3.929(-9) 1.398(-13)	
96	Curium	1.0(0)-1.689(0) N1 1.689(0)-4.012(0) M5 4.012(0)-4.231(0) M4 4.231(0)-4.839(0) M3 4.839(0)-5.945(0) M2 5.945(0)-6.322(0) M1 6.322(0)-1.8982(1) L3 1.8982(1)-2.3635(1) L2 2.3635(1)-2.4535(1) L1 2.4535(1)-1.2853(2) K 1.2853(2)-1.0(3) 1.0(3)-1.0(4) 1.0(4)-1.0(5)	1.493(1) 1.520(1) 1.677(1) 1.672(1) 1.692(1) 1.726(1) 1.711(1) 1.849(1) 1.816(1) 1.853(1) 1.897(1) 1.690(1) 1.072(1)	-1.734(0) -2.220(0) -2.732(0) -2.454(0) -2.485(0) -2.640(0) -2.538(0) -2.713(0) -2.496(0) -2.561(0) -2.363(0) -2.456(0) -2.104(0) -1.285(0)	-2.478(-4) 4.175(-7) -9.139(-10)	-3.623(-12)	
97	Berkelium	1.0(0)-1.755(0) N1 1.755(0)-4.132(0) M5 4.132(0)-4.364(0) M4 4.364(0)-4.977(0) M3 4.977(0)-6.147(0) M2 6.147(0)-6.526(0) M1 6.526(0)-1.4952(1) L3 1.9452(1)-2.4385(1) L2 2.4385(1)-2.5275(1) L1 2.5275(1)-1.3159(2) K 1.3159(2)-1.0(3) 1.0(3)-1.0(4) 1.0(4)-1.0(5)	1.496(1) 1.526(1) 1.669(1) 1.676(1) 1.696(1) 1.723(1) 1.715(1) 1.851(1) 1.798(1) 1.856(1) 1.888(1) 1.843(1) 1.082(1)	-1.746(0) -2.234(0) -2.640(0) -2.456(0) -2.483(0) -2.597(0) -2.536(0) -2.704(0) -2.428(0) -2.556(0) -2.336(0) -2.338(0) -1.291(0)	-2.357(-4) -2.693(-4) 4.950(-5) -4.205(-9) 8.043(-7)	4.446(-7) -4.205(-9) 1.549(-13)	-1.970(-10)

TABLE I (Contd.)

Z	Element	Photon Energy Range, keV	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	P <sub>4</sub>	P <sub>5</sub>
98	Californium	1.0(0)-1.822(0) N1	1.500(1)	-1.754(0)			
		1.822(0)-4.254(0) M5	1.532(1)	-2.246(0)			
		4.254(0)-4.502(0) M4	1.665(1)	-2.583(0)			
		4.502(0)-5.117(0) M3	1.680(1)	-2.455(0)			
		5.117(0)-6.353(0) M2	1.705(1)	-2.516(0)			
		6.353(0)-6.735(0) M1	1.733(1)	-2.629(0)			
		6.735(0)-1.992(1) L3	1.718(1)	-2.533(0)			
		1.992(1)-2.5125(1) L2	1.856(1)	-2.709(0)			
		2.5125(1)-2.603(1) L1	1.847(1)	-2.570(0)			
		2.603(1)-1.35005(2) K	1.858(1)	-2.550(0)	-2.406(-4)		
		1.35005(2)-1.0(3)	1.874(1)	-2.296(0)	-3.107(-4)	4.979(-7)	-2.220(-10)
		1.0(3)-1.0(4)	1.856(1)	-2.352(0)	5.106(-5)	-4.426(-9)	1.658(-13)
		1.0(4)-1.0(5)	1.086(1)	-1.291(0)	8.056(-7)	-3.736(-12)	
99	Einsteinium	1.0(0)-1.891(0) N1	1.502(1)	-1.719(0)			
		1.891(0)-4.378(0) M5	1.537(1)	-2.256(0)			
		4.378(0)-4.644(0) M4	1.673(1)	-2.606(0)			
		4.644(0)-5.259(0) M3	1.694(1)	-2.522(0)			
		5.259(0)-6.564(0) M2	1.711(1)	-2.525(0)			
		6.564(0)-6.949(0) M1	1.729(1)	-2.587(0)			
		6.949(0)-2.0414(1) L3	1.722(1)	-2.532(0)			
		2.0414(1)-2.5883(1) L2	1.861(1)	-2.713(0)			
		2.5883(1)-2.6803(1) L1	1.852(1)	-2.572(0)			
		2.6803(1)-1.38502(2) K	1.866(1)	-2.566(0)	-1.800(-4)		
		1.38502(2)-1.0(3)	1.869(1)	-2.278(0)	-3.290(-4)	5.248(-7)	-2.366(-10)
		1.0(3)-1.0(4)	1.836(1)	-2.314(0)	4.691(-5)	-3.871(-9)	1.396(-13)
		1.0(4)-1.0(5)	1.082(1)	-1.281(0)	7.514(-7)	-3.461(-12)	
100	Fermium	1.0(0)-1.961(0) N1	1.505(1)	-1.718(0)			
		1.961(0)-4.504(0) M5	1.543(1)	-2.266(0)			
		4.504(0)-4.791(0) M4	1.687(1)	-2.667(0)			
		4.791(0)-5.403(0) M3	1.715(1)	-2.624(0)			
		5.403(0)-6.781(0) M2	1.720(1)	-2.558(0)			
		6.781(0)-7.168(0) M1	1.708(1)	-2.465(0)			
		7.168(0)-2.0907(1) L3	1.726(1)	-2.533(0)			
		2.0907(1)-2.6659(1) L2	1.863(1)	-2.706(0)			
		2.6659(1)-2.7594(1) L1	1.862(1)	-2.591(0)			
		2.7594(1)-1.42085(2) K	1.865(1)	-2.548(0)	-2.051(-4)		
		1.42085(2)-1.0(3)	1.907(1)	-2.359(0)	-2.294(-4)	4.127(-7)	-1.929(-10)
		1.0(3)-1.0(4)	1.696(1)	-2.086(0)	2.345(-5)	-8.348(-10)	
		1.0(4)-1.0(5)	1.091(1)	-1.286(0)	7.552(-7)	-3.420(-12)	

TABLE II. Comparison of Computed and Tabulated Total Photoelectric Cross Sections for Germanium ( $Z = 32$ )<sup>a</sup>

$E_{\gamma}$ , keV	$\sigma_{\tau}$ Tabulated, barns	$\sigma_{\tau}$ Calculated, barns	Difference, %
1.0(0)	2.26(5)	2.26(5)	~0
1.217(0) L3	1.42(5)	1.42(5)	~0
	7.04(5)	7.04(5)	~0
1.248(0) L2	6.20(5)	6.20(5)	~0
	8.84(5)	8.84(5)	~0
1.413(0) L1	6.66(5)	6.66(5)	~0
	7.56(5)	7.71(5)	+1.9
1.5(0)	6.60(5)	6.63(5)	+0.4
2.0(0)	3.23(5)	3.18(5)	-1.5
3.0(0)	1.14(5)	1.12(5)	-1.8
4.0(0)	5.37(4)	5.28(4)	-1.7
5.0(0)	2.93(4)	2.92(4)	-0.4
6.0(0)	1.75(4)	1.78(4)	+1.9
8.0(0)	7.82(3)	8.04(3)	+2.8
1.0(1)	4.18(3)	4.23(3)	+1.3
1.1104(1) K	3.20(3)	3.11(3)	-2.8
	2.41(4)	2.46(4)	+2.1
1.5(1)	1.09(4)	1.08(4)	-0.9
2.0(1)	4.98(3)	4.97(3)	-0.2
3.0(1)	1.62(3)	1.61(3)	-0.6
4.0(1)	7.02(2)	7.07(2)	+0.6
5.0(1)	3.65(2)	3.67(2)	+0.6
6.0(1)	2.13(2)	2.13(2)	~0
8.0(1)	9.08(1)	8.98(1)	-1.1
1.0(2)	4.60(1)	4.62(1)	+0.5
1.5(2)	1.33(1)	1.33(1)	~0
2.0(2)	5.70(0)	5.62(0)	-1.5
3.0(2)	1.72(0)	1.72(0)	~0
4.0(2)	7.62(-1)	7.68(-1)	+0.8
5.0(2)	4.20(-1)	4.24(-1)	+0.9
6.0(2)	2.69(-1)	2.67(-1)	-0.8
8.0(2)	1.36(-1)	1.36(-1)	~0
1.0(3)	8.62(-2)	8.61(-2)	-0.1
1.5(3)	3.94(-2)	4.05(-2)	+2.7
2.0(3)	2.47(-2)	2.48(-2)	+0.3
3.0(3)	1.30(-2)	1.31(-2)	+0.8
4.0(3)	8.94(-3)	8.79(-3)	-1.7
5.0(3)	6.74(-3)	6.60(-3)	-2.0
6.0(3)	5.33(-3)	5.31(-3)	-0.5
8.0(3)	3.74(-3)	3.81(-3)	+2.0
1.0(4)	2.92(-3)	2.95(-3)	+0.9
1.5(4)	1.80(-3)	1.78(-3)	-1.1
2.0(4)	1.33(-3)	1.33(-3)	~0

<sup>a</sup>Tabulated cross sections from Storm and Israel.<sup>3</sup> These tables do not list cross sections when they are  $\lesssim 0.001$  barn. Calculated cross sections determined from Eq. 5 with parameters  $p_i$  from Table I. Numerical notation  $A(n) \equiv A \times 10^n$ . The positions of the K, L1, L2, and L3 absorption edges are labeled.

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